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**ASSEMBLY FOR TOOLLESS INSTALLATION AND LOCKING OF A
PRINTED CIRCUIT CARRIER TO A SYSTEM**

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BACKGROUND OF THE INVENTION

[0001] Information storage devices are fundamental building blocks in computing, communications, and data storage. A common information storage device is a hard disk drive, or hard drive, that can generally store large data quantities and enable fast read and write access to stored data. A hard drive stores data on one or more magnetic storage platters that are rotated by a spindle motor using multiple read/write heads. Signals read or written by the head are amplified by one or more preamplifiers. Hard drive internal components are encased in a housing assembly with a cover, and are sealed tightly in a clean room environment. The drive also contains a printed circuit assembly (PCA). The printed circuit assembly houses drive electronics that enable the hard drive to communicate with a processor or controller, and enables synchronous operation of the hard drive components. PCA electronics commonly include a microprocessor that controls drive functions, interface electronics for communicating with the processor's interface bus, a controller application-specific integrated circuit (ASIC) that operates all controller hardware for the drive, a read channel to encode and decode data, and a motor ASIC to drive the motor and actuator coil.

[0002] As technology progresses, hard drives have increased density while storing larger data quantities at greater access speed. The increased density of hard drives, and in electronic devices in general, has made assembly and maintenance more difficult. The difficulty of handling and accessing tiny components and devices can increase the time for production and servicing, thereby increasing costs. A particular challenge is the handling and manipulation of tiny hardware, such as screws, that are used to secure parts

of electronic devices. Manipulation of tools to engage the hardware increases time and costs of production and maintenance, whether tasks are performed manually or robotically.

SUMMARY

[0003] What are desired are structures and components, and associated operating methods, that enable toolless service, and maintenance of electronic devices.

[0004] In accordance with an embodiment of a lock assembly for securing a printed circuit assembly to a housing, the lock assembly comprises a pivot point for coupling the lock assembly to the housing, and a lock member capable of rotating and snapping into a detent in the printed circuit assembly to hold the printed circuit assembly in place.

[0005] In accordance with other embodiments, an electronic device comprises a housing, and a lock assembly capable of securing a printed circuit assembly to the housing. The lock assembly comprises a pivot point for coupling the lock assembly to the housing, and a lock member that is capable of rotating and snapping into a detent in the printed circuit assembly to hold the printed circuit assembly in place.

[0006] In accordance with further embodiments, a method for securing a printed circuit assembly to an electronic device comprises coupling a lock assembly to a housing so that the lock assembly can be rotated between an extended position and a retracted position and providing a printed circuit assembly configuration that is capable of fitting over keyways coupled to the housing. The method further comprises inserting the printed circuit assembly in alignment with the keyways with the lock assembly in the retracted position, and rotating the lock assembly over the printed circuit assembly and securing the printed circuit assembly.

[0007] According to additional embodiments, an electronic device comprises means for housing electronic and/or electromechanical components, means for securing a printed circuit assembly to the housing means, means for pivotally coupling the securing means to the housing means so that the securing means can be rotated between an extended

position and a retracted position, and means for keying the printed circuit assembly to the housing means.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Embodiments of the invention relating to both structure and method of operation, may best be understood by referring to the following description and accompanying drawings.

[0009] **FIGUREs 1A, 1B, 1C, and 1D** are pictorial diagrams that depict perspective rear/side view, perspective rear/top view, and respective opposing side views illustrating an embodiment of an electronic device utilizing a toolless lock assembly for holding a printed circuit assembly.

[0010] **FIGUREs 2A and 2B** are pictorial diagrams illustrating rear and front views of a printed circuit assembly that can be held using an embodiment of the toolless lock assembly.

[0011] **FIGURE 3** is a flow chart illustrating a method of assembling or configuring a hard disk drive.

DETAILED DESCRIPTION

[0012] A locking assembly **102** locks a printed circuit assembly (PCA) to a cage, chassis, or housing **106** without using any hardware, for example screws, and consumes a reduced amount of space. A locking member **110**, for example constructed from a rigid but flexible material such as sheet metal, rotates over a printed circuit assembly **104** as shown in **FIGURE 1A**, and snaps into a detent **116** in the printed circuit assembly, securing the printed circuit assembly in place within keyways **112** on the rear of an electronic device cage, chassis, or housing **106**. In an illustrative example, a suitable electronic device **100** is a hard disk drive, the housing **106** a hard disk drive cage, and the printed circuit assembly **104** a hard disk drive PCA. In the illustrative embodiment, the locking assembly **102** is a piece of sheet metal attached to the hard disk drive cage **106**,

forming a flexible attachment that enables the locking member **110** to extend over and apply a pre-load to the printed circuit assembly **104**.

[0013] When the hard disk drive printed circuit assembly **104** is to be removed, the locking member **110** is rotated and unlocked using a finger access detail **114** and the printed circuit assembly **104** can be lifted off the keyways **112** and away from the cage **106**.

[0014] The structure and operating method enable the hard disk drive printed circuit assembly **104** to lock into place without utilizing screws or other hardware, tools, or additional parts or components. The lock assembly **102** is incorporated into the hard disk drive cage **106** so that loose parts are eliminated that may otherwise be left out of the system or, if improperly installed, cause damage to other system components. The locking assembly **102** can have a finger access detail **114** that enables a user to easily lock and unlock the printed circuit assembly **104** from the system.

[0015] The structures and operating methods for using the locking assembly **102** eliminate the need for hardware or tools to lock the printed circuit assembly into place in a location within a system that is typically highly space-constrained. Generally, electronic components such as hard disk drives are mounted in vertical stacks in a cabinet with little or no space between components.

[0016] Elimination of screws or other hardware for securing a printed circuit assembly avoids or eliminates usage of tools within a constrained space, thereby reducing installation and service time, and reducing cost.

[0017] Referring to **FIGUREs 1A, 1B, 1C, and 1D**, pictorial diagrams depict perspective rear/side view, perspective rear/top view, and respective opposing side views an embodiment of an electronic device **100** utilizing a toolless lock assembly **102** for holding a printed circuit assembly **104**. The electronic device **100** comprises a housing **106**, and the lock assembly **102** that is capable of securing the printed circuit assembly **104** to the housing **106**. The lock assembly **102** comprises a pivot point **108** for coupling the lock assembly **102** to the housing **106**, and a lock member **110** that is capable of

rotating and snapping into a detent 116 in the printed circuit assembly 104 to hold the printed circuit assembly 102 in place.

[0018] The detent 116 in the printed circuit assembly enables the rotating locking member 110, for example a rotating cam, to lock into place and minimize the possibility or prevent the locking member 110 from loosening or disengaging due to vibration or other motion. The detent 116 assists the compressive force applied by the locking member 110 in securely holding the printed circuit assembly 104 in place.

[0019] The electronic device 100 further includes keyways 112 that are formed on the housing 106 and are capable of accepting and seating the printed circuit assembly 104. The keyways 112 have a geometric and topological configuration that is configured and oriented to limit access to the suitably contoured printed circuit assembly structure. Examples of keyways 112 include appropriate grooves or slots for accepting connection members of the printed circuit assembly 104. In other examples, the housing 106 includes extending arms or members that fit within grooves or apertures in the printed circuit assembly. The printed circuit assembly 104 is contoured to fit in the keyways 112 and secured by the lock assembly 102.

[0020] In an illustrative embodiment the lock member 110 is constructed from sheet metal and couples to the housing 106 only at the pivot point 108. The sheet metal is rigid but flexible so that the lock assembly 102 applies a pre-load to the printed circuit assembly 104 when the lock assembly 102 is engaged. In some embodiments, including the illustrative embodiment, a finger access detail 114 is formed into the lock member 110 to facilitate grasping the lock member 110 using a finger to engage or disengage the printed circuit assembly 104.

[0021] In the illustrative embodiment, all components of the lock assembly 102 are firmly affixed to the housing 106, in particular the pivot point 108 is generally intended for permanent fixture to the lock member 110 and the housing 106, so that no additional parts or hardware are used to secure the printed circuit assembly 104.

[0022] In the illustrative embodiment, the housing **106** is a hard disk drive housing and the printed circuit assembly **102** is a hard disk drive printed circuit assembly. The disclosed structures can otherwise be used to secure printed circuit assemblies or cards to housings, chassis, or cages in other types of electronic equipment.

[0023] Referring to **FIGURES 2A** and **2B**, pictorial diagrams illustrating rear and front views of a printed circuit assembly **104** that can be held using an embodiment of the toolless lock assembly **102**. Connectors **200** mounted on the printed circuit assembly **104** receive a cable **202** that supplies signal connections to the electronic device **100**.

[0024] Referring to **FIGURE 3**, a flow chart depicts a method for securing a printed circuit assembly to an electronic device **300**. The method comprises coupling a lock assembly to a housing **302** so that the lock assembly can be rotated through an extended position and a retracted position, and providing a printed circuit assembly configuration **304** that is capable of fitting over keyways attached to the housing. The method further comprises installing the printed circuit assembly in alignment with the keyways **306** with the lock assembly in the retracted position. The lock assembly is rotated over the printed circuit assembly **308**, securing the printed circuit assembly

[0025] Typically, the lock member is constructed from a rigid but flexible material such as sheet metal to produce a tension that snaps the lock assembly into place **310** over the printed circuit assembly to hold the printed circuit assembly in place. Accordingly, the lock member applies a preload to the printed circuit assembly **312** with a detent in the printed circuit board that secures the printed circuit assembly to the housing.

[0026] The printed circuit assembly locks into place using a single piece lock assembly that is integral with the housing so that no additional parts or hardware are used to secure the printed circuit assembly.

[0027] The illustrative method describes a technique for affixing a hard disk drive printed circuit assembly to a hard drive cage. The same method can be used to secure any type of assembly to a housing, chassis, or cage.

[0028] While the present disclosure describes various embodiments, these embodiments are to be understood as illustrative and do not limit the claim scope. Many variations, modifications, additions and improvements of the described embodiments are possible. For example, those having ordinary skill in the art will readily implement the steps necessary to provide the structures and methods disclosed herein, and will understand that the process parameters, materials, and dimensions are given by way of example only. The parameters, materials, and dimensions can be varied to achieve the desired structure as well as modifications, which are within the scope of the claims. Variations and modifications of the embodiments disclosed herein may also be made while remaining within the scope of the following claims. For example, the specific examples of electronic devices described herein are hard drives or hard disk drives. The disclosed systems, devices, and methods may be used with any suitable electronic devices.